

(2) A test shall be conducted to demonstrate that an overpressure of 15 psi applied to the pre-deployed refuge alternative structure for 0.2 seconds does not allow gases to pass through the structure separating the interior and exterior atmospheres.

(3) A test shall be conducted to demonstrate that a flash fire of 300 °F for 3 seconds does not allow gases to pass from the outside to the inside of the structure.

(4) An inspection shall be conducted to determine that the overpressure forces of 15 psi applied to the pre-deployed refuge alternative structure for 0.2 seconds does not prevent the stored components from operating.

(5) An inspection shall be conducted to determine that a flash fire of 300 °F for 3 seconds does not prevent the stored components from operating.

(6) A test shall be conducted to demonstrate that each structure resists puncture and tearing when tested in accordance with ASTM D2582-07 *Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting*. This publication is incorporated by reference. The Director of the Federal Register approves this incorporation by reference in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. A copy may be obtained from the American Society for Testing Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428-2959. A copy may be inspected at any MSHA Coal Mine Safety and Health district office,; or at MSHA's Office of Standards, 1100 Wilson Blvd., Room 2353, Arlington, Virginia 22209 (phone: 202-693-9440); or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to: [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

(7) A test shall be conducted to demonstrate that each reasonably anticipated repair can be completed within 10 minutes of opening the storage space for repair materials and tools.

(8) A test shall be conducted to demonstrate that no harmful gases or noticeable odors are released from non-metallic materials before or after the

flash fire test. The test shall identify the gases released and determine their concentrations.

(c) If pressurized air is used to deploy the structure or maintain its shape, the structure shall—

(1) Include a pressure regulator or other means to prevent over pressurization of the structure, and

(2) Provide a means to repair and repressurize the structure in case of failure of the structure or loss of air pressure.

(d) The refuge alternative structure shall provide a means—

(1) To conduct a preshift examination, without entering the structure, of components critical for deployment; and

(2) To indicate unauthorized entry or tampering.

#### § 7.506 Breathable air components.

(a) Breathable air shall be supplied by compressed air cylinders, compressed breathable-oxygen cylinders, or boreholes with fans installed on the surface or compressors installed on the surface. Only uncontaminated breathable air shall be supplied to the refuge alternative.

(b) Mechanisms shall be provided and procedures shall be included so that, within the refuge alternative,—

(1) The breathable air sustains each person for 96 hours,

(2) The oxygen concentration is maintained at levels between 18.5 and 23 percent, and

(3) The average carbon dioxide concentration is 1.0 percent or less and excursions do not exceed 2.5 percent.

(c) Breathable air supplied by compressed air from cylinders, fans, or compressors shall provide a minimum flow rate of 12.5 cubic feet per minute of breathable air for each person.

(1) Fans or compressors shall meet the following:

(i) Be equipped with a carbon monoxide detector located at the surface that automatically provides a visual and audible alarm if carbon monoxide in supplied air exceeds 10 parts per million (ppm).

(ii) Provide in-line air-purifying sorbent beds and filters or other equivalent means to assure the breathing air quality and prevent condensation, and

include maintenance instructions that provide specifications for periodic replacement or refurbishment.

(iii) Provide positive pressure and an automatic means to assure that the pressure is relieved at 0.18 psi, or as specified by the manufacturer, above mine atmospheric pressure in the refuge alternative.

(iv) Include warnings to assure that only uncontaminated breathable air is supplied to the refuge alternative.

(v) Include air lines to supply breathable air from the fan or compressor to the refuge alternative.

(A) Air lines shall be capable of preventing or removing water accumulation.

(B) Air lines shall be designed and protected to prevent damage during normal mining operations, a flash fire of 300 °F for 3 seconds, a pressure wave of 15 psi overpressure for 0.2 seconds, and ground failure.

(vi) Assure that harmful or explosive gases, water, and other materials cannot enter the breathable air.

(2) Redundant fans or compressors and power sources shall be provided to permit prompt re-activation of equipment in the event of failure.

(d) Compressed breathable oxygen shall—

(1) Include instructions for deployment and operation;

(2) Provide oxygen at a minimum flow rate of 1.32 cubic feet per hour per person;

(3) Include a means to readily regulate the pressure and volume of the compressed oxygen;

(4) Include an independent regulator as a backup in case of failure; and

(5) Be used only with regulators, piping, and other equipment that is certified and maintained to prevent ignition or combustion.

(e) The applicant shall prepare and submit an analysis or study demonstrating that the breathable air component will not cause an ignition.

(1) The analysis or study shall specifically address oxygen fire hazards and fire hazards from chemicals used for removal of carbon dioxide.

(2) The analysis or study shall identify the means used to prevent any ignition source.

**§ 7.507 Air-monitoring components.**

(a) Each refuge alternative shall have an air-monitoring component that provides persons inside with the ability to determine the concentrations of carbon dioxide, carbon monoxide, oxygen, and methane, inside and outside the structure, including the airlock.

(b) Refuge alternatives designed for use in mines with a history of harmful gases, other than carbon monoxide, carbon dioxide, and methane, shall be equipped to measure the harmful gases' concentrations.

(c) The air-monitoring component shall be inspected or tested and the test results shall be included in the application.

(d) The air-monitoring component shall meet the following:

(1) The total measurement error, including the cross-sensitivity to other gases, shall not exceed  $\pm 10$  percent of the reading, except as specified in the approval.

(2) The measurement error limits shall not be exceeded after start-up, after 8 hours of continuous operation, after 96 hours of storage, and after exposure to atmospheres with a carbon monoxide concentration of 999 ppm (full-scale), a carbon dioxide concentration of 3 percent, and full-scale concentrations of other gases.

(3) Calibration gas values shall be traceable to the National Institute for Standards and Technology (NIST) "Standard Reference Materials" (SRMs).

(4) The analytical accuracy of the calibration gas and span gas values shall be within 2.0 percent of NIST gas standards.

(5) The detectors shall be capable of being kept fully charged and ready for immediate use.

**§ 7.508 Harmful gas removal components.**

(a) Each refuge alternative shall include means for removing harmful gases.

(1) Purging or other effective procedures shall be provided for the airlock to dilute the carbon monoxide concentration to 25 ppm or less and the methane concentration to 1.0 percent